Effect of CP-Nozzle Setup On Spray Distribution and Swath Width

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Introduction

Spray distribution across the swath is important to applicators because:

- Poor distribution decreases effective swath width, and
- Poor distribution reduces the efficiency of the application performance

Introduction

- Uniformity of spray distribution can be affected by
  - Condition of spray system
  - Air turbulence created by the flight of the airplane
  - Wind interactions with air turbulence
- Every spray plane should be evaluated for typical boom setups

Introduction

Effective Swath Width = the largest swath width associated with the minimum acceptable coefficient of variation (CV).

(ASAE STANDARDS, 1999)

CV% = Standard Deviation / Average * 100

Introduction

- Alternative definition –
  - Effective swath width is the distance between samplers receiving one half the maximum deposit received any one sampler in the swath.
  - This approach is described in detail by Gardisser and Kulhman (1993) and is also included in the ASAE Standards, 1999

Objective

To evaluate the effect of CP-Nozzle setup on spray distribution and swath width

Methods and Materials

- Air Tractor 402B
  - Standard drop-boom kit (lowered boom ~ 6″)
  - AutoCal II automatic flow control
  - 62 CP-Straight Stream Nozzles
- Spray mix – 6 pints Induce / 100 gal water plus Rubidium tracer
- Application rate of 3 gpa on 65′ swath

Methods and Materials

- 38 horizontal fallout samplers at 1 m intervals in line perpendicular to flight
- Sample media – 5” square Mylar
- Collection in leak-proof zip-lock bags
- Rinsed with 0.1% Nitric Acid to recover Rubidium
- Analyzed on Atomic Absorption Spectrometer with a PQL of 0.7 ppb

Methods and Materials

- Weather Station – on site
  - Time-of-Day | 10:30 – 3:30 |
  - Wind speed and direction | light & variable |
  - Air temperature | 88 ^{o}F average |
  - Relative humidity | 45 % average |
- Measured every second, logged every 5 s
- Time-of-day synchronized with time keeper's watch

Methods and Materials

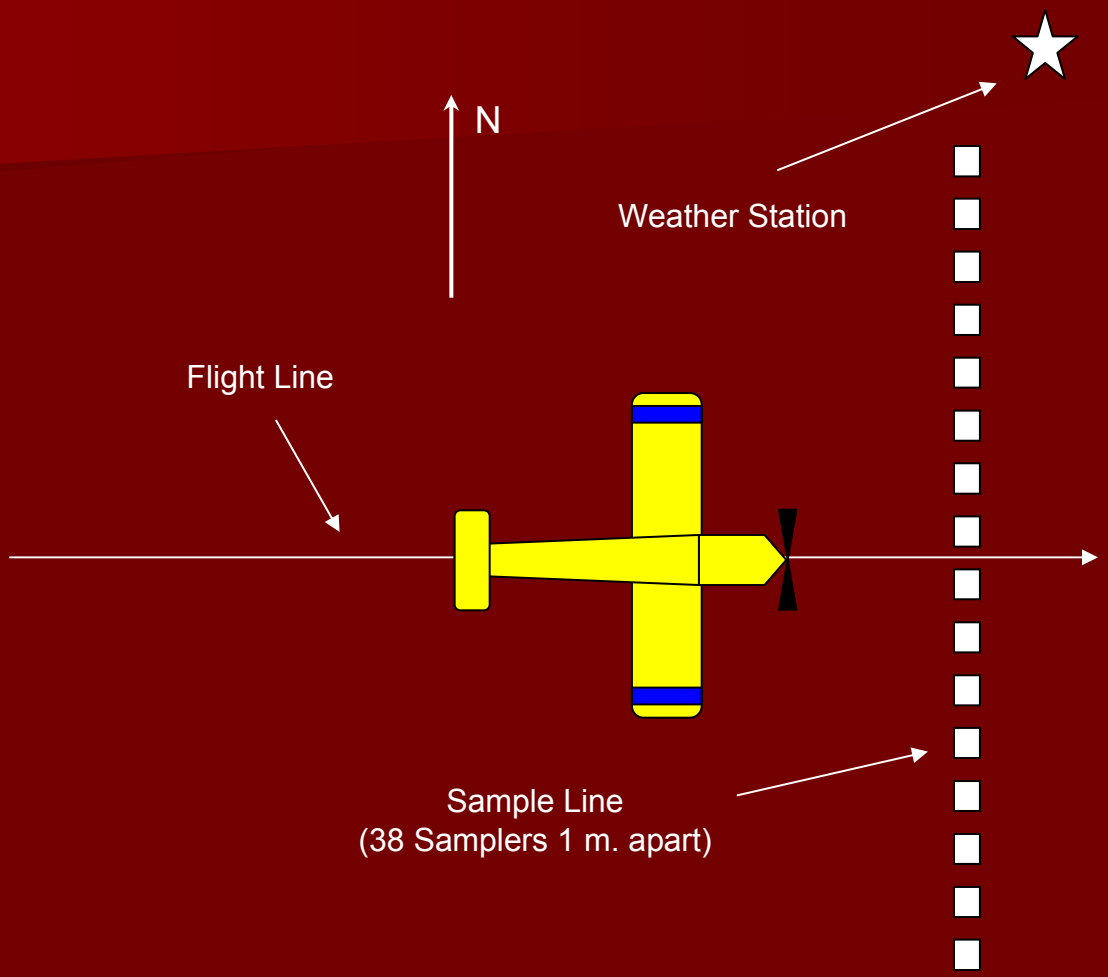
- Treatments
  - T1) 0.078” orifice (#5); 5 degree deflector
  - T2) 0.062” orifice (#4); 5 degree deflector
  - T3) 0.078” orifice (#5); Straight Stream
  - T4) 0.062” orifice (#4); Straight Stream
- Treatments were randomly applied in blocks replicated 4 times

Methods and Materials

- Simulated swath width
  - Generated from single pass deposition data
  - For the swath width being analyzed, overlap the treatment deposition data by positioning each single pass set a distance of 1 swath over from the previous set.
  - Accumulate deposition from overlapped sampler positions
  - Three swaths overlapped – Two analyzed

Methods and Materials

- Graphical Analysis
  - Minimum deposition greater than 50% of intended application
  - 95% of swath width characterized by deposits greater than 60% of intended application


N
Weather Station
Flight Line
Sample Line
(38 Samplers 1 m. apart)

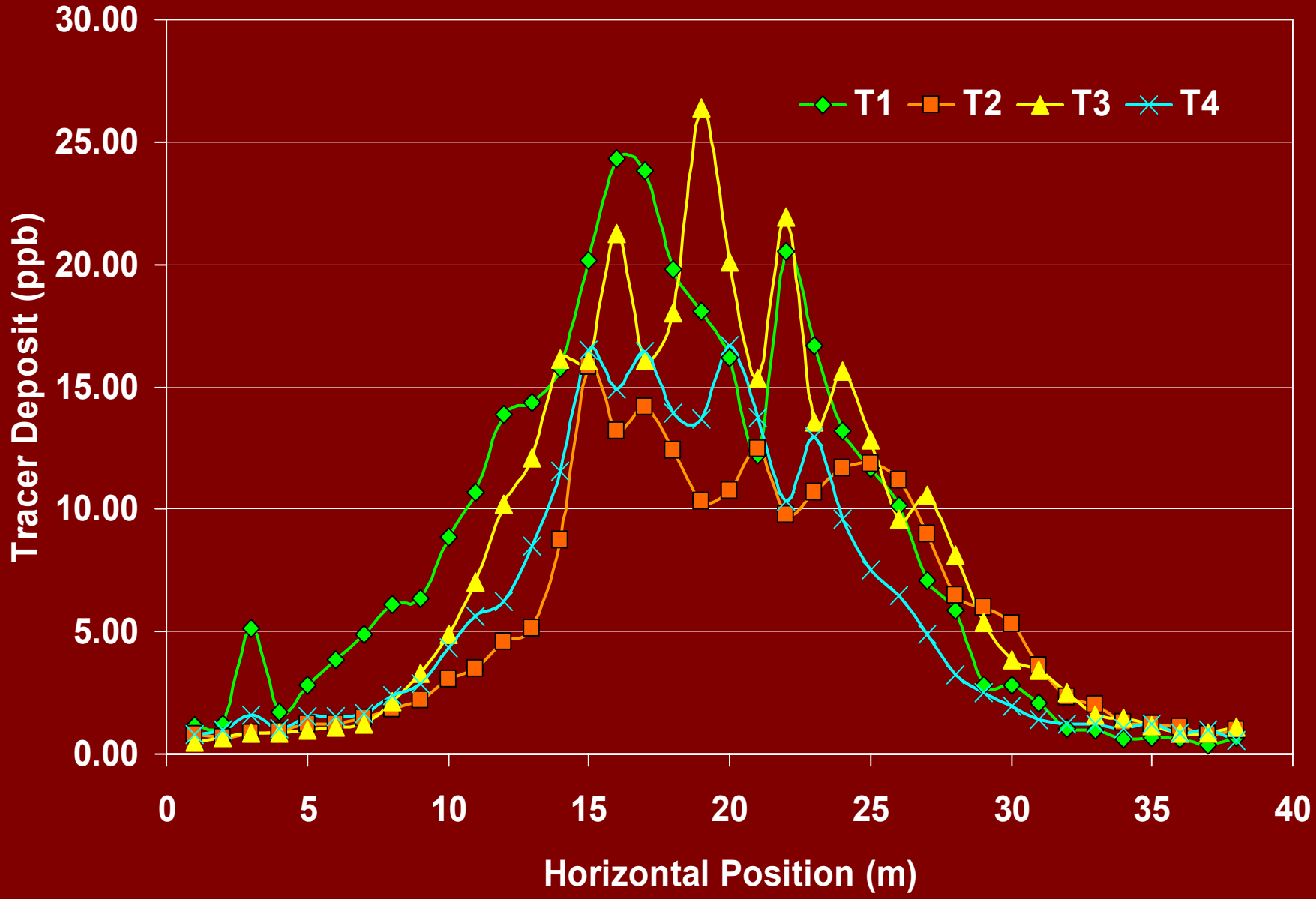
4-Dec-04

Results

Treat	Orifice Diameter	Deflector	Pressure (psi)	VMD (microns)
1	.078	5 Deg	30	309
2	.062	5 Deg	73	398
3	.078	SS	30	355
4	.062	SS	73	447

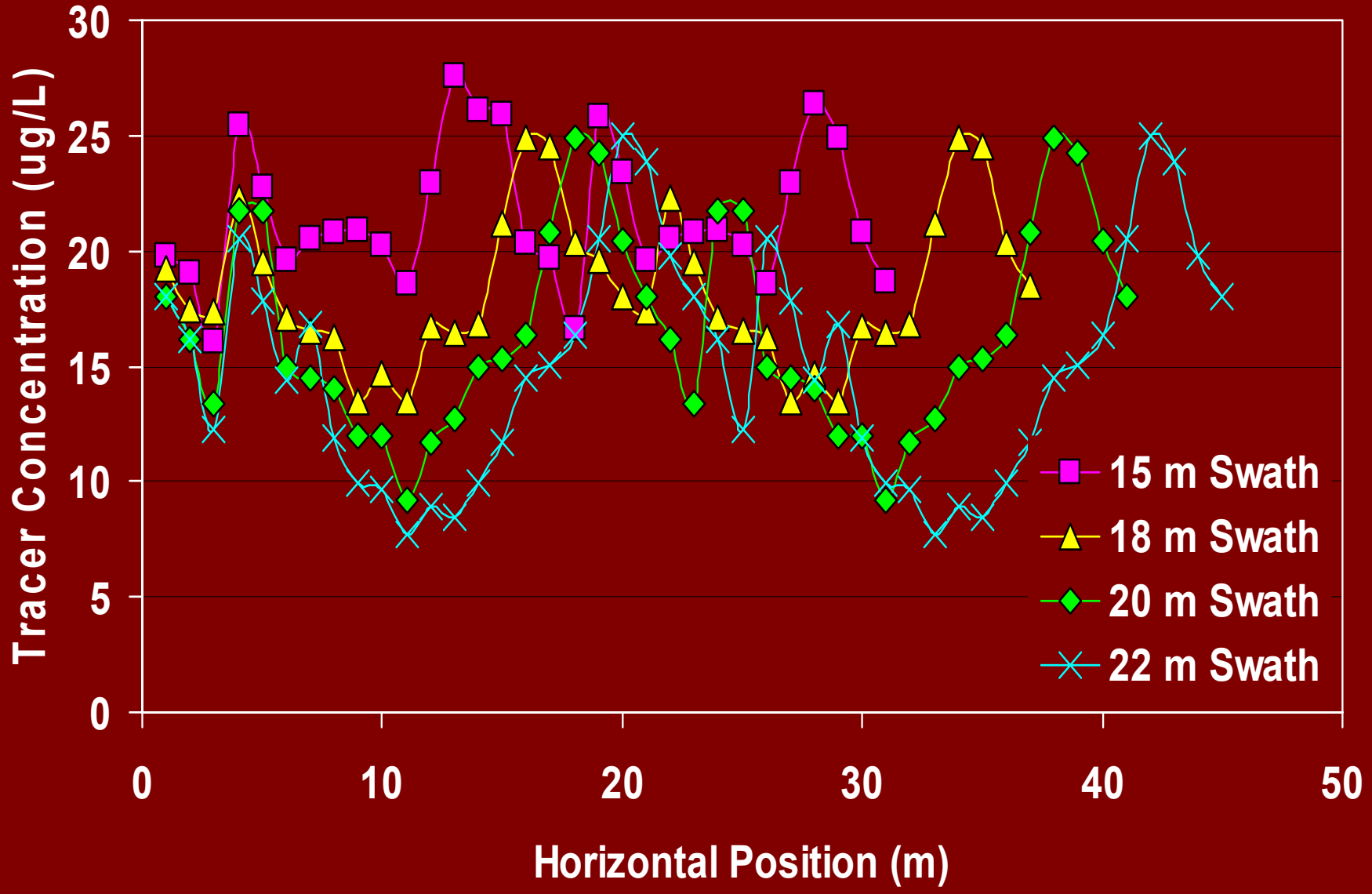
Results

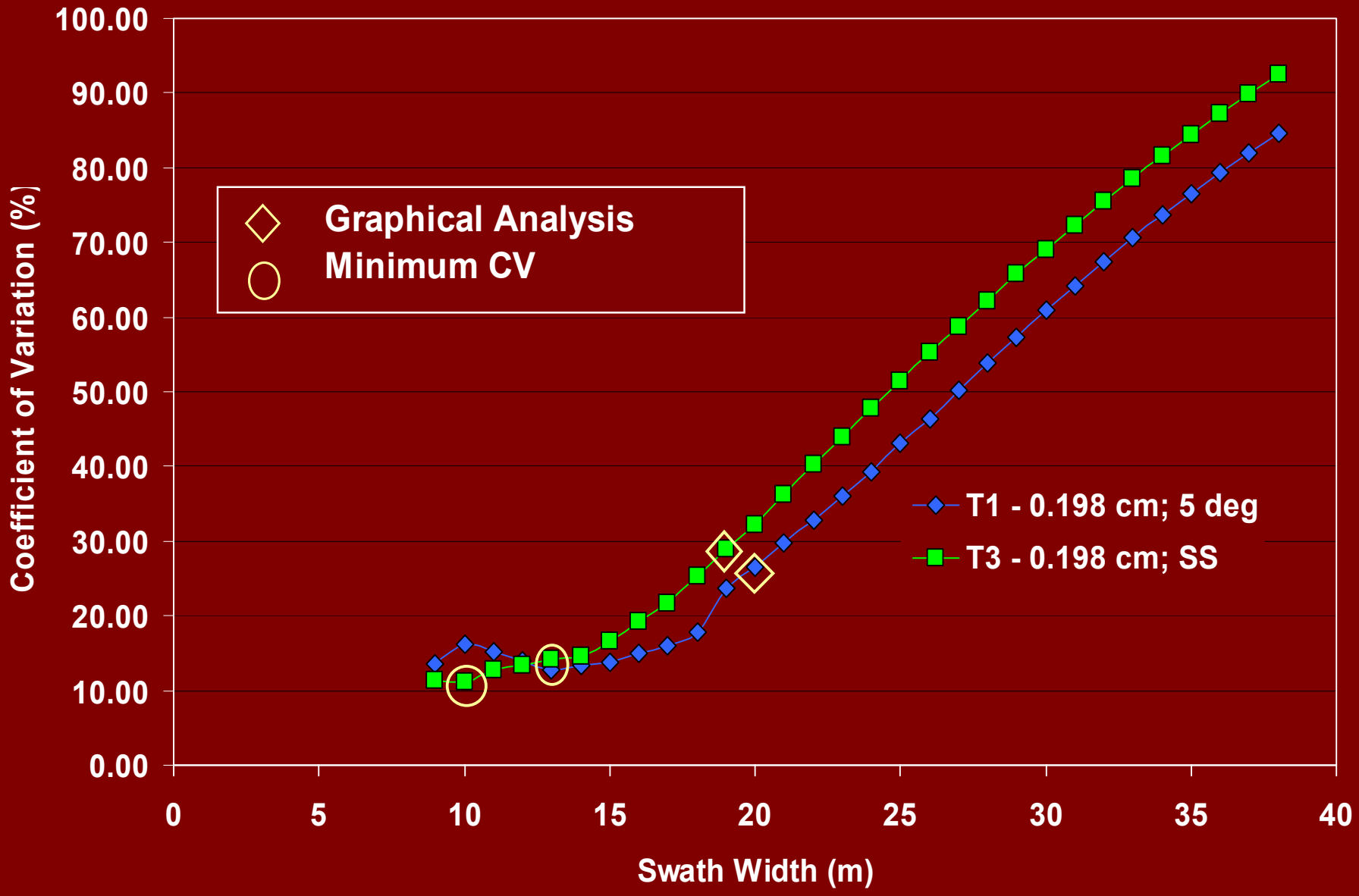
Source	Deposit (ug)	Source	Deposit (ug)	Coef. Of Variation (%)
Treat 1	0.1733	0.062	0.1170	103.90
Treat 2	0.1161	0.078	0.1681	101.33
Treat 3	0.1629	5 Deg	0.1447	96.94
Treat 4	0.1180	SS	0.1404	108.28
$LSD_{[05]}$	0.0462	$LSD_{[05]}$	0.0125	5.41

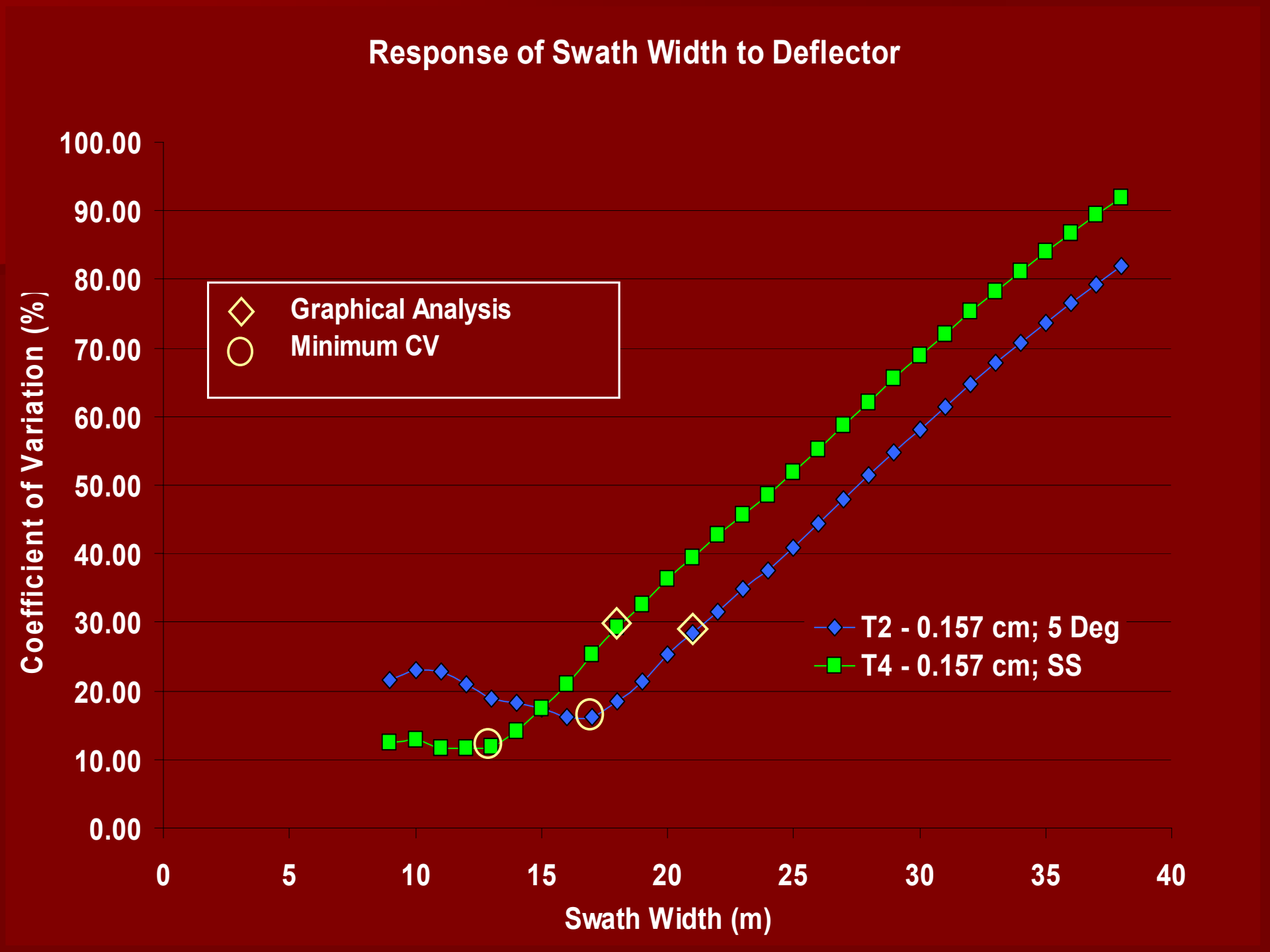

30.00
25.00
20.00
15.00
10.00
5.00
0.00
Tracer Deposit (ppb)
T1
T2
T3
T4
0
5
10
15
20
25
30
35
40
Horizontal Position (m)

Results

Treat	Graphical Analysis		Minimum CV		Half Max Deposit	
	Swath (m)	CV (%)	Swath (m)	CV (%)	Swath (m)	CV %
1	20	26.5	13	12.8	14	45.3
2	21	28.5	17	18.2	14	43.9
3	19	28.9	10	13.5	12	49.0
4	18	29.2	13	11.9	13	49.2


Tracer Concentration (ug/L)
30
25
20
15
10
5
0
0
10
20
30
40
50
Horizontal Position (m)
15 m Swath
18 m Swath
20 m Swath
22 m Swath


100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Coefficient of Variation (%)
0
5
10
15
20
25
30
35
40
Swath Width (m)
Graphical Analysis
Minimum CV
T1 - 0.198 cm; 5 deg
T3 - 0.198 cm; SS


Response of Swath Width to Deflector
Coefficient of Variation (%)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0
5
10
15
20
25
30
35
40
Swath Width (m)
Graphical Analysis
Minimum CV
T2 - 0.157 cm; 5 Deg
T4 - 0.157 cm; SS

Conclusions

- Deposition was not adversely affected by the use of SS deflection compared to 5 Degree deflection
- For this setup and application rate the 'minimum acceptable CV' appears to be 28 or 29
- The use of Straight Stream deflection reduced effective swath width by 2 to 3 m